

Identifying Distant Halo Giants in High-Latitude Fields with K2: C6

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The stellar content and structure of the Galactic halo constrain star formation at the earliest epochs, and halo mass and assembly. The best remote tracers are K giants, for their high luminosities render them visible to 100 kpc, and their presence in populations of all metallicities and ages ensure an unbiased sample. However the difficulty of separating distant giants from foreground dwarfs at faint magnitudes has led to choosing preferentially metal-poor giant candidates. Our goal here is to use K2 light curves, which lack this bias, to identify dozens of giants 35 \square 100 kpc above the Galactic plane in this lightly-reddened area at high Galactic latitude, the first step in determining the metallicity distribution of the outer halo.

This proposal is relevant to the Kepler K2 Guest Observer solicitation because new K2 observations are the only way to find remote giants without invoking an explicit low-metallicity bias. Previous work relies on spectra or photometric indices to select metal-poor candidates for scarce follow-up resources, to increase the odds of finding halo giants. K2 does not need this as it can identify all cool giants from their light curves, and can record a thousand potential targets at once. Kepler could also, but the Kepler field is centered at low Galactic latitude, $b = +13.5^\circ$, a line of sight that remains close to the Galactic plane. Reddening is significant and variable, and halo giants are swamped by dwarfs of the disk/thick disk. K2 data acquired in the high-latitude fields C1 and C3 include very few suitable STAR targets. Obtaining new K2 data in the upcoming K2 high-latitude fields C6, C8, C10, and C12 now offers a unique opportunity to identify hundreds of remote halo giants without explicit color or line-strength cuts based on metallicity.

We propose K2 C6 long-cadence observations of 1152 distant giant candidates at Galactic latitude b from 48° to 53° , with $E(g-r) \sim 0.04$. These include all on-silicon EPIC stars with SDSS ugriz photometry, $0.60 \leq g-r < 1.1$, proximity $> 12 \square$ if given, and proper motion < 11 mas/yr. Except for a brighter faint Kp limit below $g-r < 0.7$, these targets all have $16 < Kp < 18.5$, too faint for direct GAIA or APOGEE spectroscopy. Our faint Kp limit is that required for peak detection in a giant power spectrum, based on introducing artificial noise into real Kepler light curves of APOKASC metal-poor giants. An external check on peak detectability and the resulting parameters will come from 26 C6 targets having SEGUE spectra, 14 dwarfs and 12 giants.

The peak frequency ν_{max} of maximum power of p-mode (solar-like) oscillations scales as gravity $g/\sqrt{\text{Teff}}$. At $0.56 < (g-r)_0 < 1.06$, such giants have $\sim 70 > \nu_{\text{max}} > \sim 1\frac{1}{4}\text{Hz}$ and temperature Teff from 5200K to 4200K. As dwarfs show no peaks here (or recognizable ones), and metal-poor subgiants and red clump stars are bluer, ν_{max} alone can separate giants from interlopers. ν_{max} will be found from power spectra derived from the K2 80-day light curves (from the positions of the strongest clustered peaks), and Teff to 100K (from $g-r$). These will fix the luminosity of a giant to $\sim 30\%$, and be confirmed via globular-cluster ugriz diagrams and existing results for individual stars. Follow-up spectroscopy of these distant giants (and adjacent dwarfs) for metallicities and velocities need observe a sky area of only 4 sq deg accessible to both UVES FLAMES and Keck DEIMOS.

For added value we will publish a catalog of all stars detected, with our values of ν_{max} , luminosity, distance, Teff , $\log g$, and a rough metallicity. We will provide a grid of high-resolution spectra calculated from first principles for metal-poor giants, archived on MAST. From these, Teff , $\log g$, and $[\text{Fe}/\text{H}]$ may be derived from optical spectra of low or high resolution for metal-poor giants in regions of both low and high reddening. This will provide important standardized input for K2/Kepler metal-poor giant seismology and other NASA investigations.